

# UNPUBLISHED PRELIMINARY DATA

Engineering Research Laboratories  
College of Engineering  
The University of Arizona  
Tucson, Arizona

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FROM : Dr. T. L. Vincent, Assistant Professor  
Aerospace and Mechanical Engineering Dept.

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Research performed on the above grant, "A Study of the Calculus of Variations, Especially as Related to Aerospace Engineering Problems," may be summarized according to the proposed objectives:

1. Establish a simple but general procedure for obtaining flight trajectories. A procedure incorporating the use of the analog computer has been established for handling a class of problem in dealing with optimum aircraft performance. The depth of application or realistic limits of the analysis remains to be determined and will be known only after thorough investigations have been carried out under objective 2.

2. Obtain a large number of minimum time, maximum range, minimum fuel consumption and other optimum trajectory solutions on the analog computer. A number of optimum trajectories have been obtained from The University of Arizona Donner analog computer using the methods of objective 1. Computer component failures have caused some delay in this area, but at the present time such difficulties appear to have been corrected.

One of the reasons for obtaining a number of optimum trajectories is to determine the practicability of flying them with present day aircraft. Sometimes an optimal trajectory turns out to be physically impossible for an

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actual aircraft to fly, other times an optimal trajectory may be either unsafe or unduly stressing on an aircraft required to fly such a trajectory. In addition, there is the question as to whether a pilot is capable of following a designated program. Whether such limitations exist, especially those concerning pilot capabilities, is not always obvious from computer results when certain maneuvers appear to be marginal.

In order to help clarify limitations of this type, permission was obtained for the principal investigator to ride as an observer on a few flights in a military aircraft. The results of these observations have been quite useful, not only in clarifying the above mentioned limitations, but the actual flight trajectories serve as a useful check on computer results. Permission is now being sought for observation rides in a higher performance aircraft.

3. Study new classes of problems in aerospace engineering requiring the calculus of variations for solution. The majority of effort in this phase of the project will be left for the latter part of the year. Some preliminary analysis has been directed toward applications involving the simultaneous optimization of two or more functionals and the application of a class of extended geodesic problems.